Virtual Human

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Abstract

A computational model of the human, the *Virtual Human*, is being developed at the Oak Ridge National Laboratory (ORNL). The *Virtual Human* will provide the capability of evaluating the effectiveness and safety levels for Non-Lethal technologies. This model could also be viewed as an engineering design tool for the development of new non-lethal technologies as well as countermeasures. In addition, the Virtual Human will be useful for evaluating human responses to new scenarios of equipment and operational conditions. Its use will minimize the need for actual human subjects being involved in testing and simulation.

It has been said that while the 20th century was the century of physics, the 21st century will be the century of biology. The Oak Ridge National Laboratory is uniquely positioned to play a leadership role in the grand challenge level problem of linking the physics and biology of humans in ways that will permit new avenues of research relating to human function and biomedical applications. The *Virtual Human* is being developed at ORNL using a three-dimensional representation based on the Visible Human data set. The *Virtual Human* will be a research/testing environment having an integrated system of biophysical and other models, data, and advanced computational algorithms. It will have a Web-based interface for easy, rapid access from several points of entry. It will serve as a platform for national and international users from governments, academia and industry to investigate the widest range of human biological and physical responses to stimuli be they biological, chemical, or physical. This effort will go far beyond the visualization of anatomy to incorporate physics, such as mechanical and electrical tissue properties and biology from physiology to biochemical information, into the platform so that responses to varied stimuli can be predicted mechanistically and results viewed three-dimensionally. Because numerous anatomical and biokinetics models, databases, informatics and visualization capabilities are locally available for integration, as well as requisite supercomputing and mass data storage devices, ORNL is better equipped to lead the development of this concept than most scientific organizations in the world. However, many other organizations have much to contribute to the final development of the Virtual Human, both from the user requirements perspective and the technical development side. Therefore, we are inviting groups that have experience in related topical areas to join with ORNL in order to help refine the focus of this program and contribute to its development.

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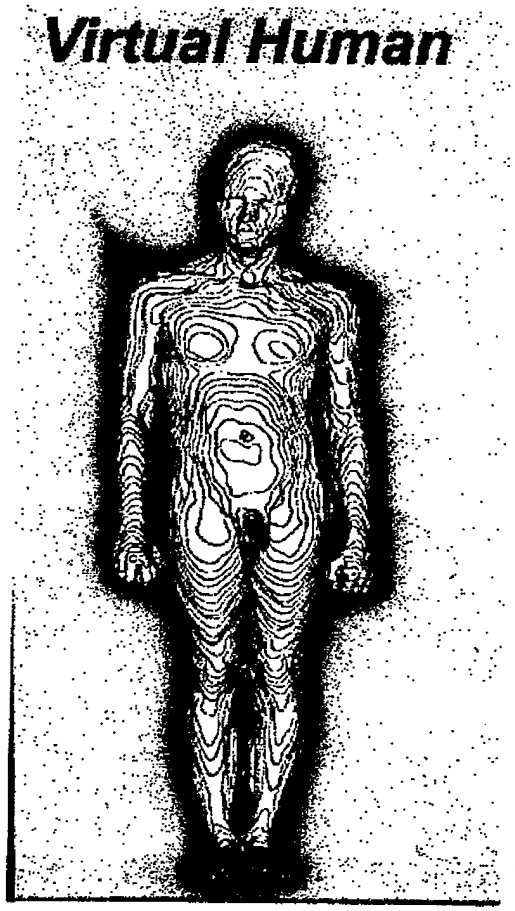
[1]Operated by Lockheed Martin Energy Research Corp., for the U.S. Department of Energy under Contract No. DE-AC05-96OR224642.

The Virtual Human: A Diagnostic Tool for Human Studies and Health Effects in the Twenty-First Century



Oak Ridge National Laboratory

Clay E. Easterly,
M. J. Maston
& the
Oak Ridge Team

Non Lethal Defense III

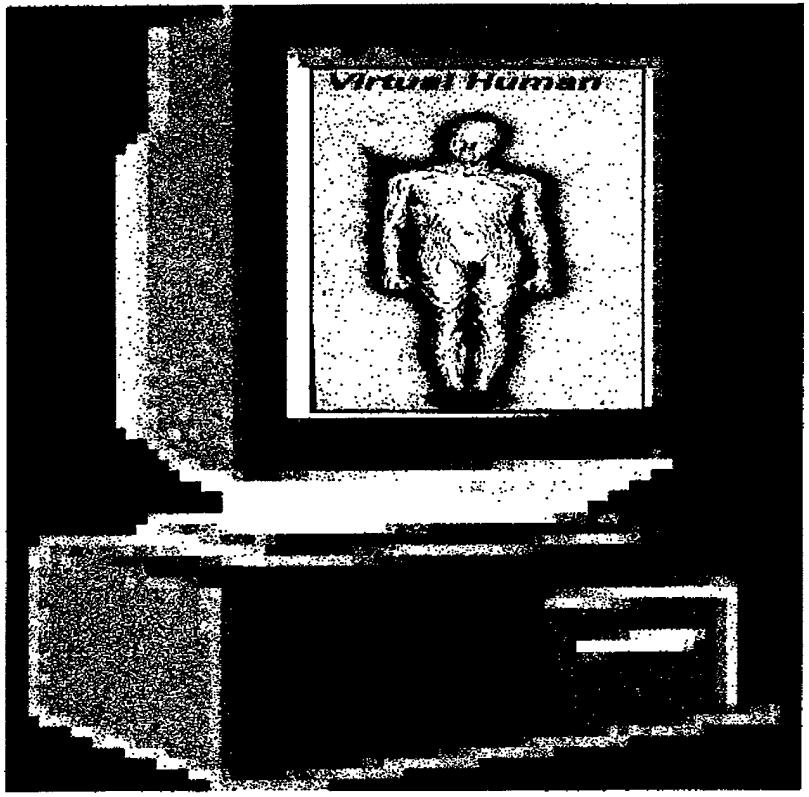
25 February, 1998

Laurel, MD

Purpose of Presentation

- Provide initial public discussion of the Virtual Human program
- Solicit feedback
- Identify potential collaborators

The Vision



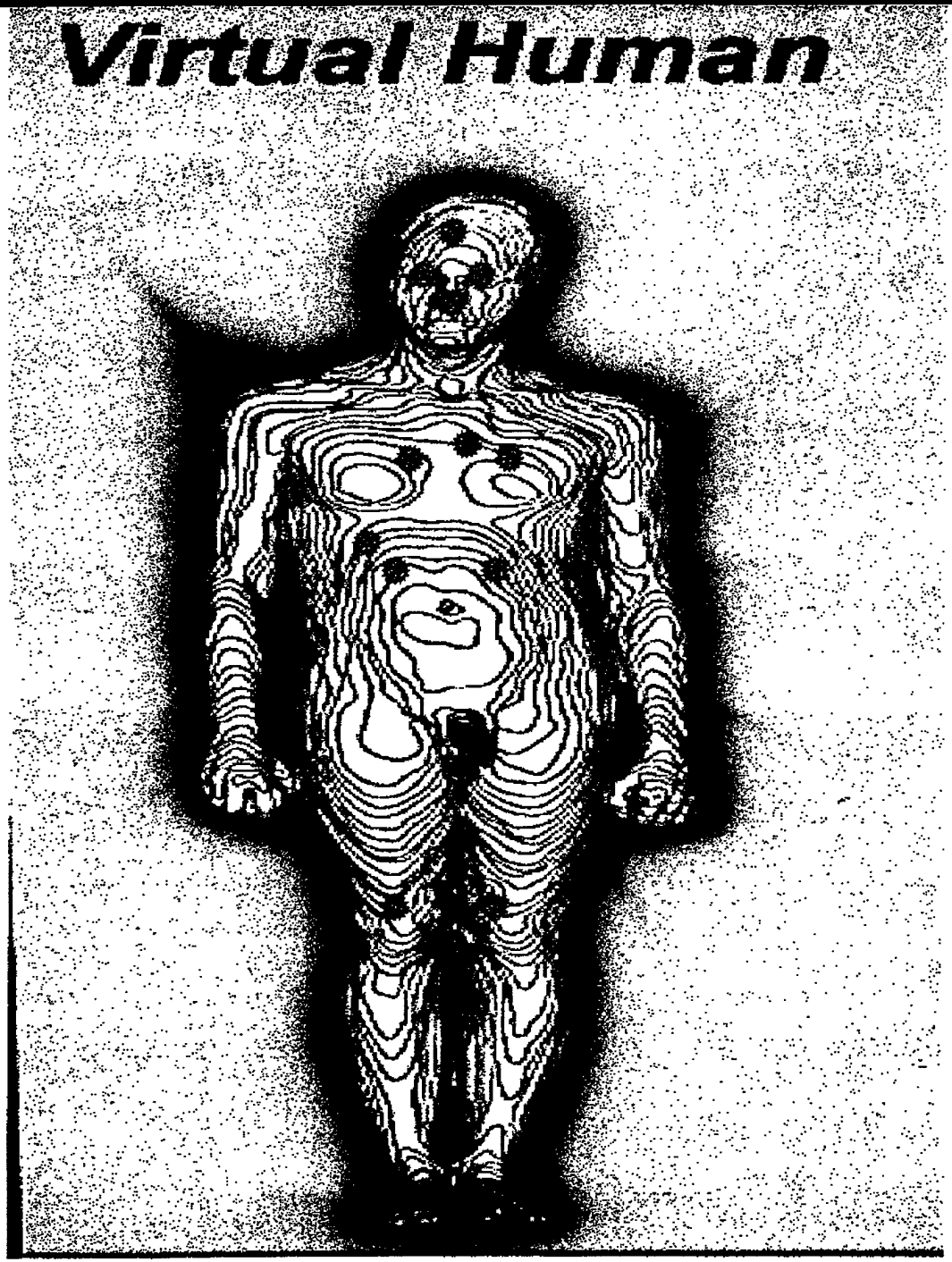
- Model the Human Body with Fidelity
- Far Beyond Anatomy
- Link Biology, Physics, Chemistry & Computational Science
- Wide Ranging Applicability
- Sponsor Adaptability

VISION (CONT'D)

- Complete system
  - physiological
  - cognitive
- Requires many collaborators
  - multiple medical communities
  - national effort
- Collaborators retain ownership of work
  - function as repository for specific expertise
- Differs from similar sounding efforts

VISION (CONT'D)

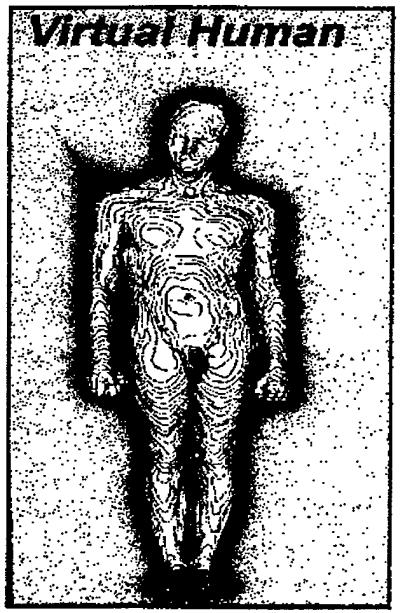
- National Laboratory role
  - coordination
  - integration
  - specific modeling
  - computational networking



Plenty of real estate available for research (and development)

- Known research ongoing

Overall Effort



- Workshops: Basic approach
- Solicit collaboration
- Identify existing data/models
- Model specific systems
- Model integrated systems
- Identify gaps
- Early prototypes 2005

- NIH, NLM, Medical Community
- DoD-Training, Simulation, Countermeasures
- Transportation Safety
- Civil Law
- DOE, Basic Science

- Cost at ORNL: Year 1 & 2 $2-4M; Year 3-10 $5-10M; Year 10+ ?
- Collaborators: (US & International)
  - National Labs
  - Universities
  - Private companies

APPLICATIONS OF MODEL

- Explore interface between engineering and medicine
- Advanced monitoring capabilities
  - injectable multifunction sensors
  - transmit data to model
  - time course of diverse information
  - sensor fusion via physiological model
  - evaluate effects of single new medications
  - set dosage and type for controlling multiple conditions

PRESENT AGENDA

- Two levels of workshops
  - small gatherings to focus on potential user needs
  - larger, public meetings to inform community and gain feedback
- Face-to-face with potential collaborators
  - Team building

PRESENT EFFORT

- Identify and support existing research
- Identify and fill voids in research
- facilitate common architecture to integrate research

Why ORNL?

Most Complete DOE Multipurpose Laboratory
In-House Collection of World Class Experts to Lead Effort

- Biology
- Engineering
- Computational Physics
- Visualization
- Risk Assessment
- Computer Design
- Human Factors
- Computational Biology
- Computational Mathematics
- Internal Dose Modeling
- Toxicological Data Bases
- Supercomputing Facilities

In Addition...

- Long-term commitment (Institutional Memory)
- History of developing and operating "User Facilities"
- Ability to protect intellectual property of users
- Significant up-front investment already in-place
  - genome project
  - super computing
- Ability to compartmentalize work (Open, Proprietary, or Classified)

Summary

- Virtual Human is a long-term program
- Planning extensive and complex
- Initial ideas of application numerous
- ORNL team believes, using example of Internet, most applications may not surface before useful model is completed
- Collaborators are being sought